



Reprocessing of Suomi-NPP/JPSS Sensor Data Records: On-Going Efforts, Plans and Preparations

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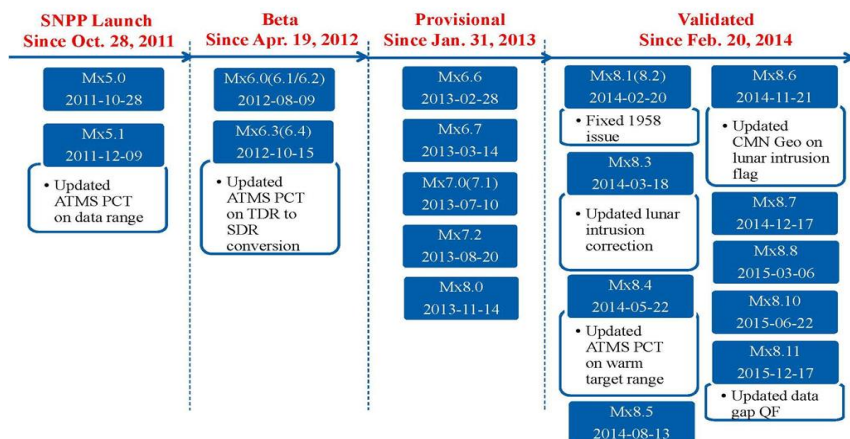
With contribution from Changyong Cao (VIIRS SDR), Hu Yang/Quanhua Liu (ATMS SDR), Trevor Beck/Ding Liang (OMPS SDR), Yong Chen/Flavio Iturbide (CrIS SDR)

" The scientific results and conclusions, as well as any views or opinions expressed herein, are those of the author(s) and do not necessarily reflect the views of NOAA or the Department of Commerce."

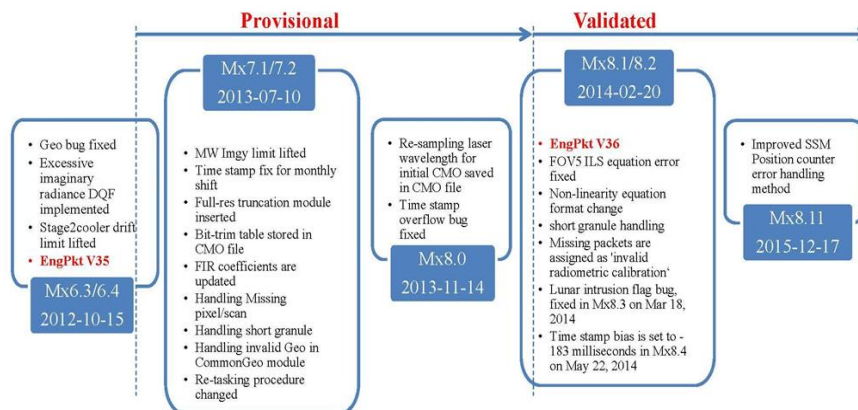
- Objectives of Suomi-NPP/JPSS Lifecycle Sensor Data Record (SDR) Reprocessing
- Suomi-NPP SDR Reprocessing Status
 - Overview on SDR Reprocessing
 - ATMS/VIIRS/CrIS/OMPS SDR Reprocessing Improvements
 - SDR Reprocessing Status and Data Access
- Summary
- Path Forward
- SDR Reprocessing Future Plan

- Optimize the algorithms and processing systems to achieve the lowest JPSS data uncertainties
- Implement the mission-life consistent sciences to achieve a long-term stability of JPSS data accuracy
- Reduce the processing anomalies to the lowest level for preserving the highest integrity of the JPSS data stream
- Incorporate the user-oriented algorithm sciences into reprocessing to further augment the societal impacts of JPSS datasets

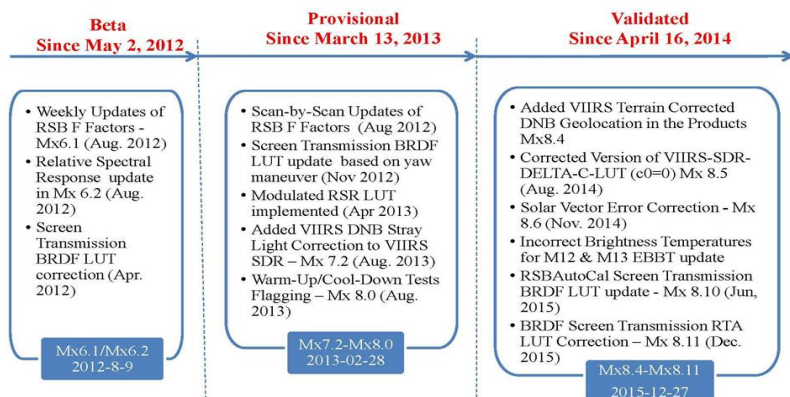
(a) ATMS SDR Algorithm Changes



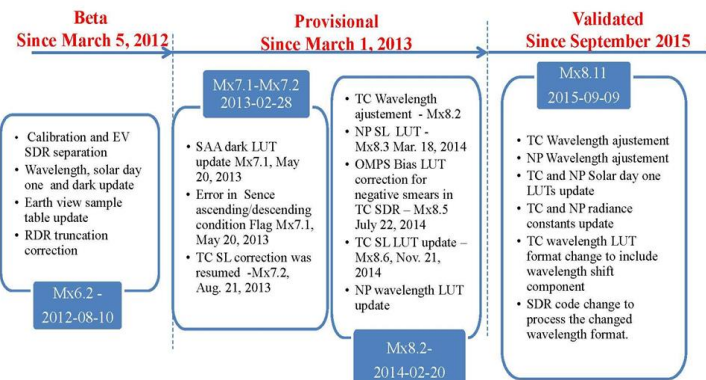
(b) CrIS SDR Algorithm Changes



(c) VIIRS SDR Algorithm Changes



(d) OMPS SDR Algorithm Changes



Each maturity stage represents an improvement in science quality

Updates	Reprocessing System	Improvements
<u>Cal/Val Algorithm Updates</u>	Using latest calibration parameters and algorithms	Consistent IDPS baseline calibration
<u>RSBs</u>	<ul style="list-style-type: none"> Baseline SDRs calibrated using consistent RSBAUTOCAL F-factors A “radiometric bias correction” term was introduced 	Addressed issues related to: <ul style="list-style-type: none"> OC hybrid calibration correction and constant bias correction for M5/M7
<u>TEBs:</u>	<ul style="list-style-type: none"> Improved BT limits, less saturation in M13 WUCD bias correction for M15/M16 	<ul style="list-style-type: none"> Improvements for fire EDR. Mitigated spikes in SST time series.
<u>DNB:</u>	<ul style="list-style-type: none"> Consistent Low Gain Stage (LGS) gain Improved offset and gain ratio; Stray light correction for the entire data records. 	More consistent data records for change studies; significant improvements in early data. Less negative radiance.
<u>Geolocation:</u>	<ul style="list-style-type: none"> Removed short-term anomalies before August 2013; DNB geolocation are terrain corrected for the entire data record. 	Consistent terrain corrected geolocation

Slide Courtesy: VIIRS SDR Team

VIIRS DNB Straylight Correction Improvements

IDPS (12/16/2012)
(No Straylight correction)

Reprocessed Data
(Straylight Corrected)

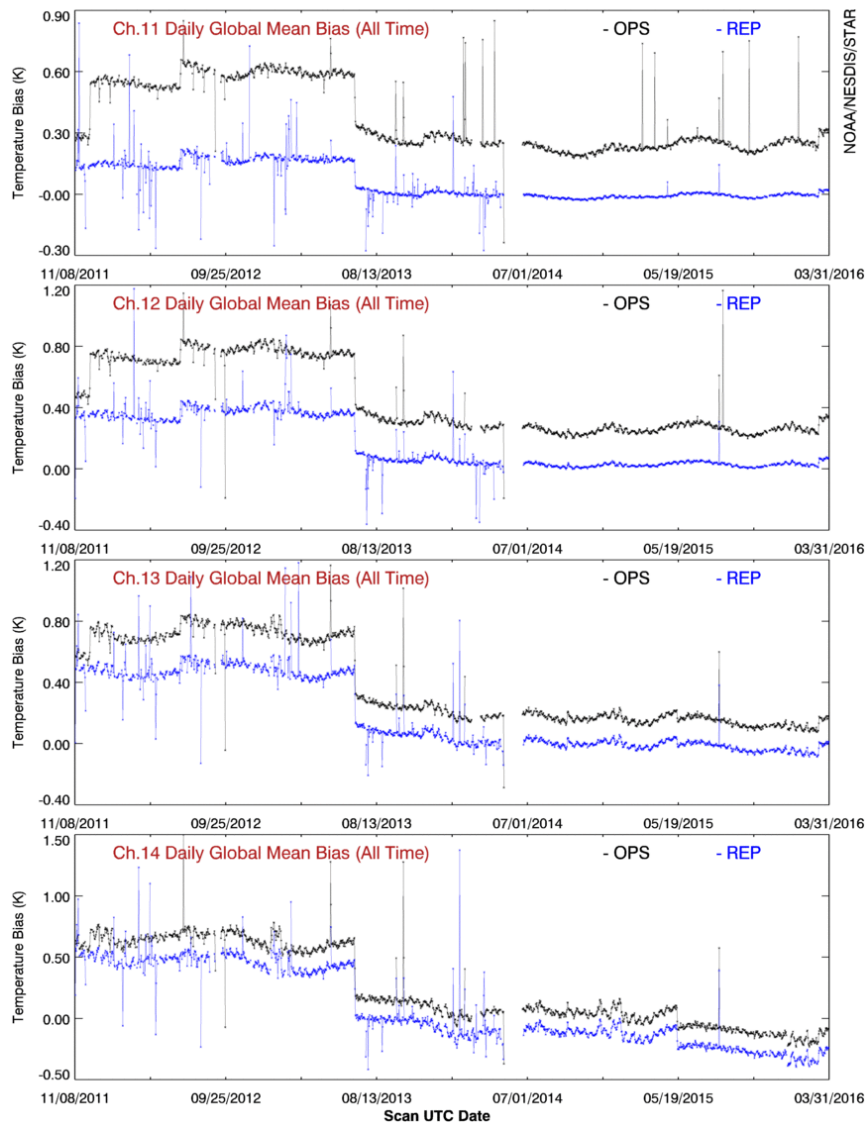
- Reprocessing implements straylight correction for all DNB SDR
- Significant improvements in all DNB data before August 2014

Courtesy: STAR VIIRS SDR Team

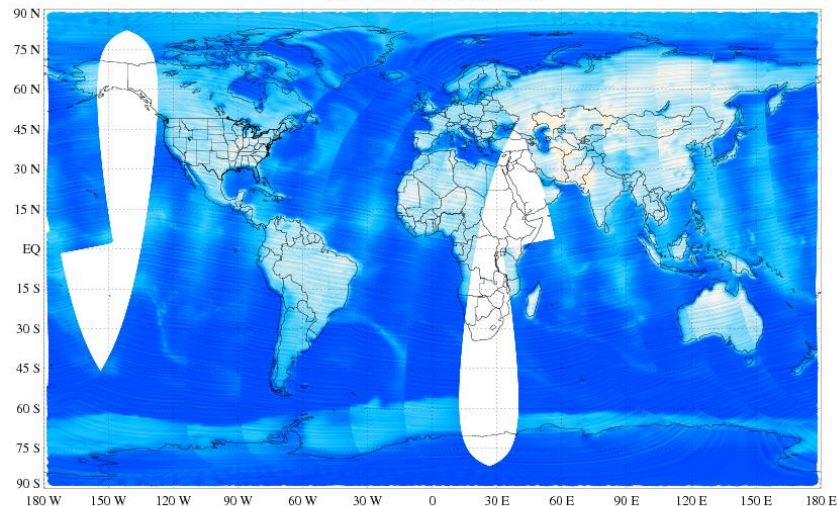
Error Source	Reprocessing System	Improvements
<u>Calibration Method</u>	Calibration in radiance space	Improve accuracy over cold region in high frequency channels
<u>Non-linearity</u>	Physical model based antenna emission correction (μ - parameters)	Correct error in coefficients and keep algorithm consistency to heritage microwave sensors
<u>Lunar Contamination</u>	Maximum threshold lunar intrusion correction algorithm	Improve the lunar intrusion prediction accuracy
<u>Noise Filtering</u>	Boxcar	Reduce the striping effect
<u>Calibration Target Quality Check</u>	Adjust raw data quality check threshold	Improve SDR data accuracy

Slide Courtesy: STAR ATMS SDR Team

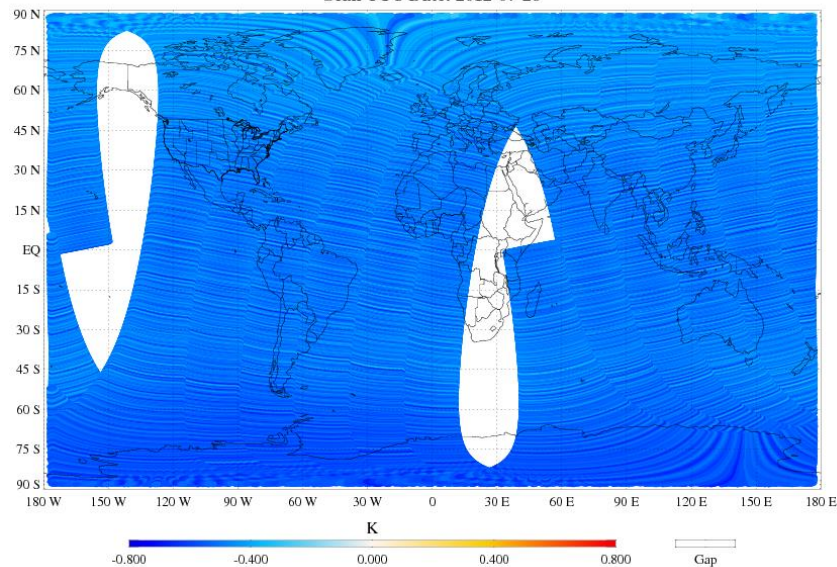
Suomi NPP ATMS TDR Daily Global Mean Bias w.r.t. ECMWF RTM SIM



S-NPP ATMS TDR Bias (Rep - OPS) Ch.1 23.8 GHz QV-POL
Scan UTC Date: 2012-07-26



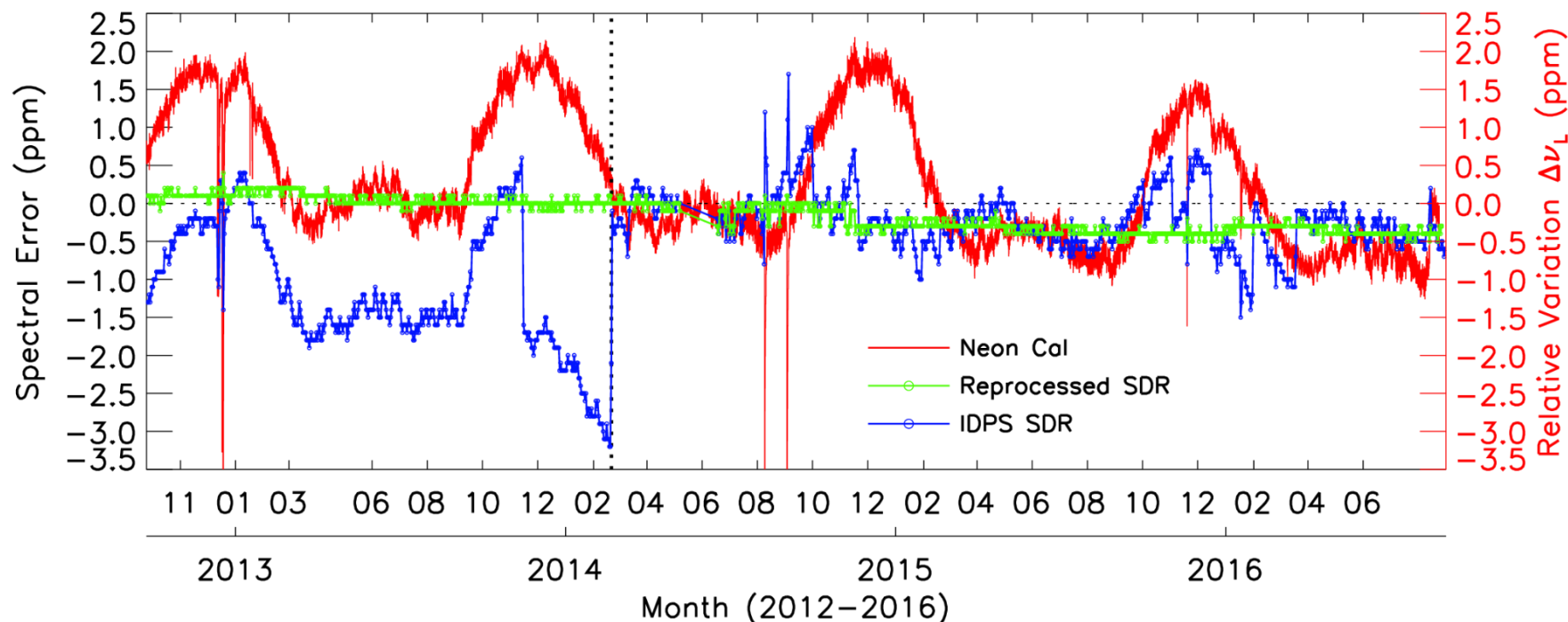
S-NPP ATMS TDR Bias (Rep - OPS) Ch.11 57.29034±0.217 GHz H-POL
Scan UTC Date: 2012-07-26



Updates	Reprocessing System	Improvements
<u>Calibration Algorithm</u>	A4 type of calibration, first spectral, then radiometric	Reduced the ringing at the band edges and improved the calibration accuracy
<u>Non-linearity coefficients</u>	New MW FOV7 a2 coefficient, and keep other FOVs a2 as the same in the latest EngPkt v37	Improved the FOV-2-FOV radiometric consistency
<u>ILS parameters</u>	Keep the ILS the same as the latest EngPkt v37	Improved the spectral accuracy from +/- 3.0 ppm to within 1 ppm
<u>Geolocation Mapping Angels</u>	Keep the mapping angels the same as the latest EngPkt v37	Improved the geolocation accuracy from 1.2 km to less than 0.3 km using VIIRS as reference

Slide Courtesy: STAR CrIS SDR Team

Comparison of CrIS spectral calibration error



- Comparison of the Neon subsystem spectral calibration versus calibration using the upwelling radiances for IDPS and reprocessed SDRs from September 22, 2012 to August 31, 2016.
- The upwelling calibration has been offset by -0.6 ppm.
- The Neon zero shift time is determined by the Correction Matrix Operator (CMO) update on December 19, 2012. The several sharp spikes in the December 19, 2012, August 9, 2014, and September 2, 2014 are due to NPP spacecraft issues, not CrIS malfunctions.
- The upwelling calibration is for the daily average of FOV5 at nadir (FOR 15 or 16), descending orbit over clear tropical ocean scenes.

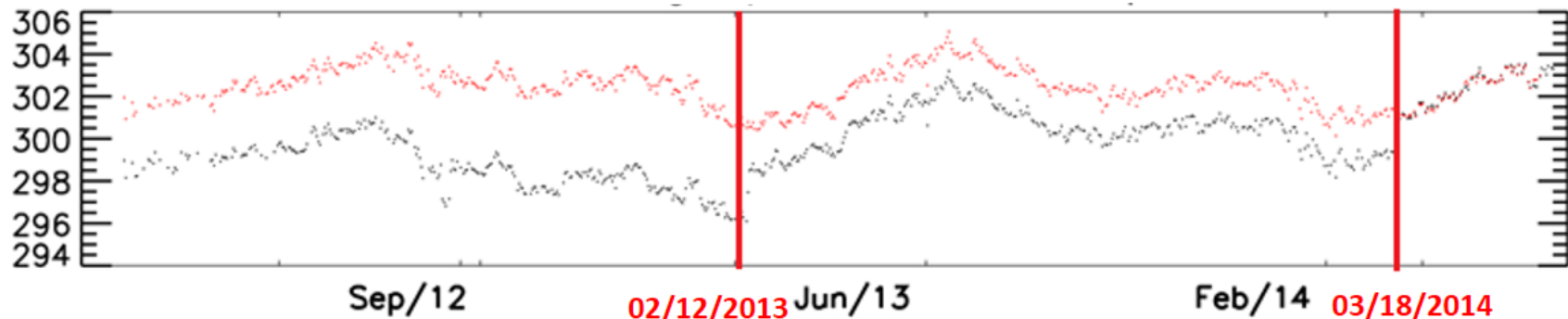
Courtesy: STAR CrIS SDR Team

Error Sources	Reprocessing System	Impact/Improvements
<u>Wavelength registration</u>	Coefficients update based on on-orbit solar irradiance measurements	Improve NP/NM SDR quality and ozone total column and profile retrieval accuracy
<u>Straylight</u>	Coefficients adjustment based on EDR performance	Consistent NP and NM SDR stray light correction algorithm. Ozone total column and profile retrieval accuracy
<u>Albedo</u>	Coefficients update based on on-orbit observations	NP/NM SDR accuracy between 300 and 310 nm channels
<u>Irradiance</u>	Calibration coefficients for solar irradiance measurements	NP/NM SDR accuracy for all channels

Courtesy: STAR OMPS SDR Team

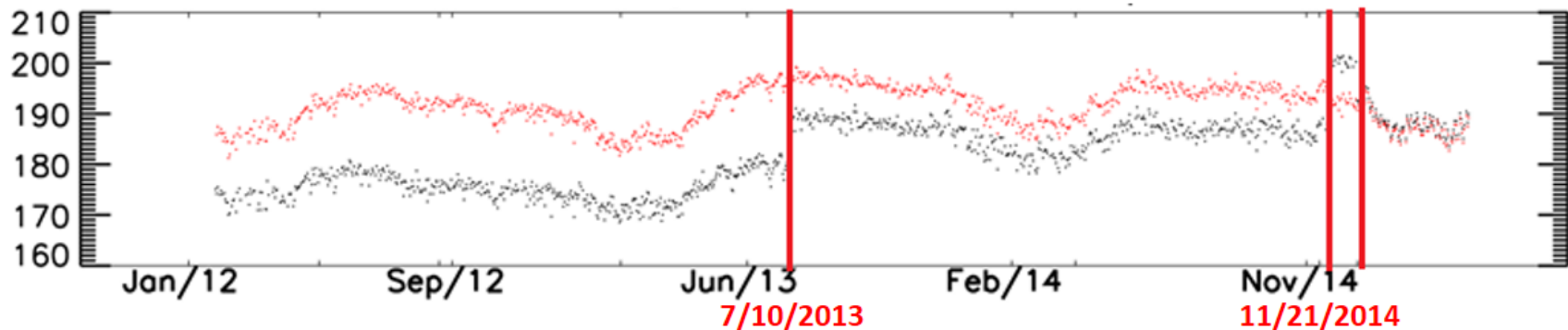
OMPS daily nadir view N-value (stability) over tropical Pacific region (20S-20N,90W-180W)

252nm N-value (Nadir Profiler)



- 02/12/2013: Start of weekly updates to NP dark LUT
- 03/18/2014: NP Stray Light correction

302nm N-value (Nadir Mapper)



- 7/10/2013: TC Stray Light temporary table update
- 11/21/2014: TC Stray Light LUT update
- 12/18/2014: TC Stray Light LUT update

Courtesy: STAR OMPS SDR Team

- Build a cost effective High Performance Computing (HPC) cluster for JPSS reprocessing and temporary archiving at <http://jlrddata.umd.edu/opensap/thredds>
- Utilize the latest version with new, fully tested, and validated science algorithms
- Integrate the latest version of PCT, LUT, and engineering packages into a baseline system for reprocessing
- Recover the missing RDR granules from every possible medium (e.g. CLASS, GRAVITE)
- Produce mission-long S-NPP Reprocessed SDRs in the same format as what provided in CLASS, and work is underway to transfer datasets to NCEI/CLASS

Sensor	Data Types	Daily Volume	Date Period	Total Days	Total Volume
ATMS	TDR+SDR+GEO	1241 MB	2011/11/08~2017/03/08	1948	2.42 TB
CrIS	NSR SDR+GEO	44.3 GB	2012/03/01~2017/03/08	1834	81.25 TB
CrIS	FSR SDR	74 GB	2014/12/04~2017/03/08	826	61.12 TB
VIIRS	SDR+GEO	415 GB	2012/02/20~2017/03/08	1845	765.68 TB
OMPS NP	SDR+GEO	261 MB	2012/01/26~2017/03/08	1869	487.81 GB
OMPS TC	SDR+GEO	3 GB	2012/01/26~2017/03/08	1869	5.61 TB
Total					916.57 TB

OPeNDAP THREDDS Catalogs

JPSS Life-Cycle Reprocessing Data Service Catalog : S-NPP ATMS Data S-NPP CrIS Data S-NPP VIIRS Data S-NPP OMPS Data

Catalog Services

Service Name	Service Type	Service Base
Hyrax	OPeNDAP	/opendap/hyrax/

Dataset

S-NPP ATMS Data/

ATMS TDR /

ATMS SDR /

ATMS GEO /

S-NPP CrIS Data/

CrIS SDR /

CrIS FSR SDR /

CrIS GEO /

S-NPP VIIRS Data/

VIIRS I-Band SDR /

VIIRS I-Band Terrain Corrected GEO /

VIIRS M-Band SDR /

VIIRS M-Band Terrain Corrected GEO /

VIIRS DNB SDR /

VIIRS DNB GEO /

S-NPP OMPS Data/

OMPS NP SDR /

OMPS NP GEO /

OMPS TC SDR /

OMPS TC GEO /

Size

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THREDDS Catalog XML

Hyrax development sponsored by [NSF](#), [NASA](#), and [NOAA](#)

OPeNDAP Hyrax (1.13.4)

[Documentation](#)

- Reprocessing SDR data has been treated as one of the JPSS data products and will go through scientific data product quality review before public release
- 1st JPSS reprocessing workshop held in 2016:
<https://www.star.nesdis.noaa.gov/jpss/meetings2016.php>
- Suomi-NPP SDR version 1 (cut-off by March 8, 2017) reprocessing has been done for evaluation
- Preliminary analysis shows that the quality of S-NPP SDR data is significantly improved after reprocessing
- Reprocessing SDR data has been sent to users, such as NWS, for further evaluation
- S-NPP reprocessing SDR is available from OPeNDAP/THREDDS for research evaluation purpose at <http://jlrddata.umd.edu/.opendap/thredds>
- Working with NCEI/CLASS on the fast access and dissemination of the reprocessed data for worldwide users
- EDR teams have demonstrated EDR reprocessing and associated improvements. Enterprise algorithms implemented for Suomi-NPP EDR products are either operational or close to operations with algorithm maturity acceptable for reprocessing.

- Work with JPSS SDR and EDR users to understand their requirement so as to better serve the data users worldwide
- Work closely with NCEI/CLASS teams to define a repeatable process for archiving current and future reprocessed data.
 - NCEI Request To Archive (R2A) has been submitted and discussed
 - CLASS/NCEI Engineering Assessment process has been started
 - Interface Control Documents development is on-going
- Integrate the accumulated SDR calibration algorithm updates after the first reprocessing in the new reprocessing system and prepare for the version 2 reprocessing

- **ATMS SDR Reprocessing Plan**
 - Antenna emission correction on calibration target and earth view scenes
 - Hybrid antenna pattern correction algorithm to improve SDR data quality
 - Model based lunar intrusion detection and correction on cold calibration targets
 - S-NPP ATMS SDR reprocessing (version 2) is planned in middle 2019
 - NOAA-20 ATMS SDR post-validated reprocessing is on-going
- **CrIS SDR Reprocessing Plan**
 - S-NPP CrIS FSR/NSR SDR reprocessing (version 2) is optional
 - NOAA-20 CrIS SDR post-validated reprocessing will be planned after validated review
- **OMPS SDR Reprocessing Plan**
 - OMPS-TC stray light correction update
 - S-NPP OMPS SDR reprocessing (version 2) is planned in early 2019
 - NOAA-20 OMPS SDR post-validated reprocessing will be planned after validated review

Updates	Ongoing V2 Reprocessing With Further Improvements
<u>Cal/Val Algorithm Updates</u>	All M&I bands: Corrected an IDPS coding error in the VIIRS DELTA-C LUT relating to CFPA temperature.
<u>RSBs</u>	<p>VIIRS SDR final Baseline product, based on re-analyzed of SD/SDSM screen and BRDF LUTs → Annual oscillation removed and further smoothed; future changes will not require fundamental reprocessing (only need bias correction).</p> <p>Support two VIIRS SDR version products through Radiometric Bias Correction terms:</p> <ol style="list-style-type: none"> 1) New OC Hybrid calibration (extended up to 03/2017). 2) STAR VIIRS SDR team's Kalman filter model F-factors, based on reconciled Lunar, DCC, SNO calibrations.
<u>TEBs:</u>	1) Improved WUCD bias correction for all bands.
<u>DNB:</u>	1) Improved calibration offsets with striping correction.

Reprocessing On-Demand

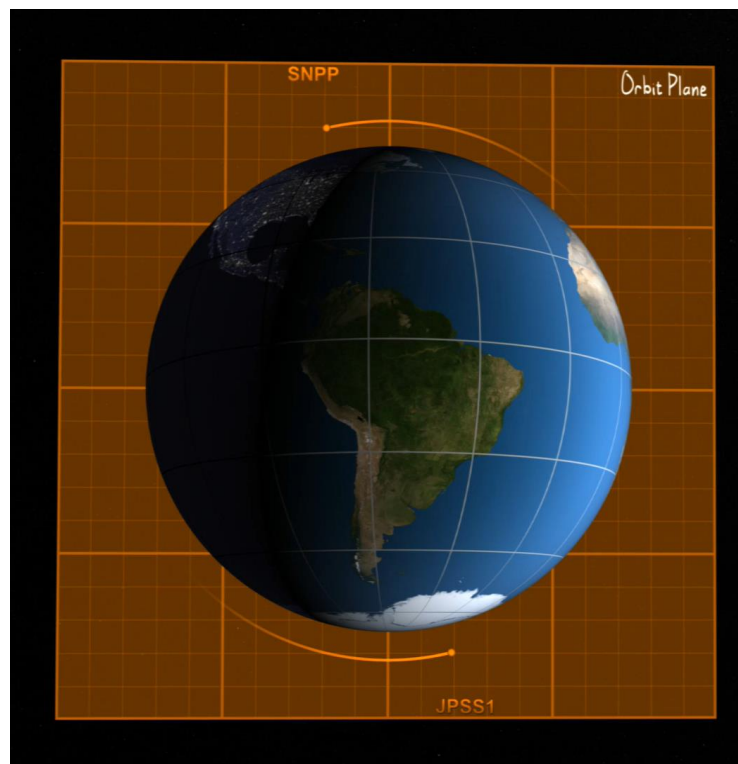
Why?

- VIIRS data volume is large (~1 PB/7 years)
There is not enough storage space
- SDR volume is 10x of RDR
- Generating SDR files on the fly is faster than transmitting over the network
- Most users don't need all the data (few have the storage capacity)

How?

- Work with specific users to define needs
- Generate the required SDRs only when needed
- User can define spatial and temporal criteria
- SDR can be either generated at STAR or user site
- Tested with NOAA-20 VIIRS DNB reprocessing
- Will provide fully reprocessed SDR to NCEI when they are ready to accept.

Slide Courtesy: Changyong Cao, VIIRS SDR Lead



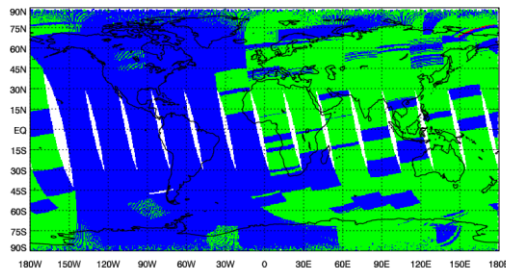
Thank you!

Backup Slides

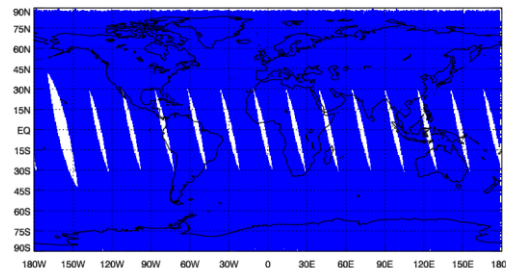
STAR CrIS Data Reprocessing (1/3)

- Engineering packet version 37 and new MW FOV7 NL a2 coefficient
- ADL Block 2.0 with A4 calibration algorithm and improved geolocation algorithm
- TSR SDR for the whole history
- FSR SDR since December 4, 2014
- Latest RDR version
- CrIS TSR data reprocessing from February 20, 2012 to August 31 2016 completed

NPP CrIS Long Wave SDR Overall Quality Flag, Mapped, Ascending, 06/27/2012
(Blue: Good; Green: Degraded; Red: Invalid) Updated at Aug 10 22:48:06 2015 UTC

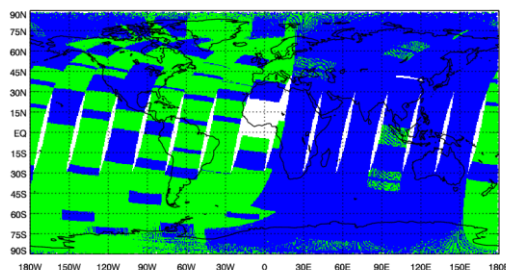


NPP CrIS Long Wave SDR Overall Quality Flag, Mapped, Ascending, 06/27/2012
(Blue: Good; Green: Degraded; Red: Invalid) Updated at Oct 7 17:34:09 2016 UTC

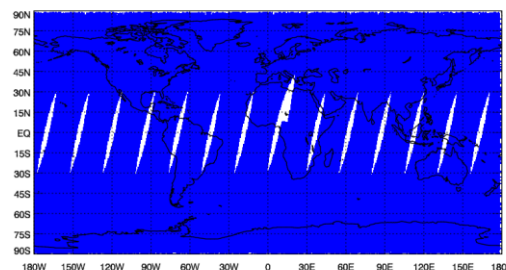


06/27/2012

NPP CrIS Long Wave SDR Overall Quality Flag, Mapped, Descending, 06/27/2012



NPP CrIS Long Wave SDR Overall Quality Flag, Mapped, Descending, 06/27/2012



IDPS SDR

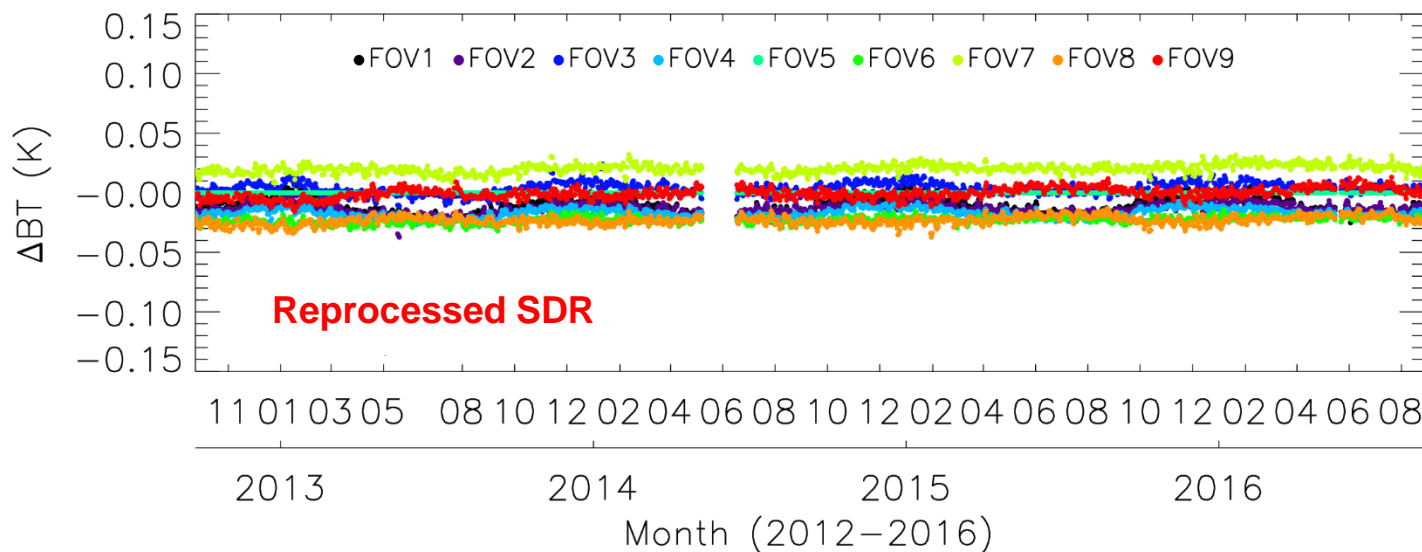
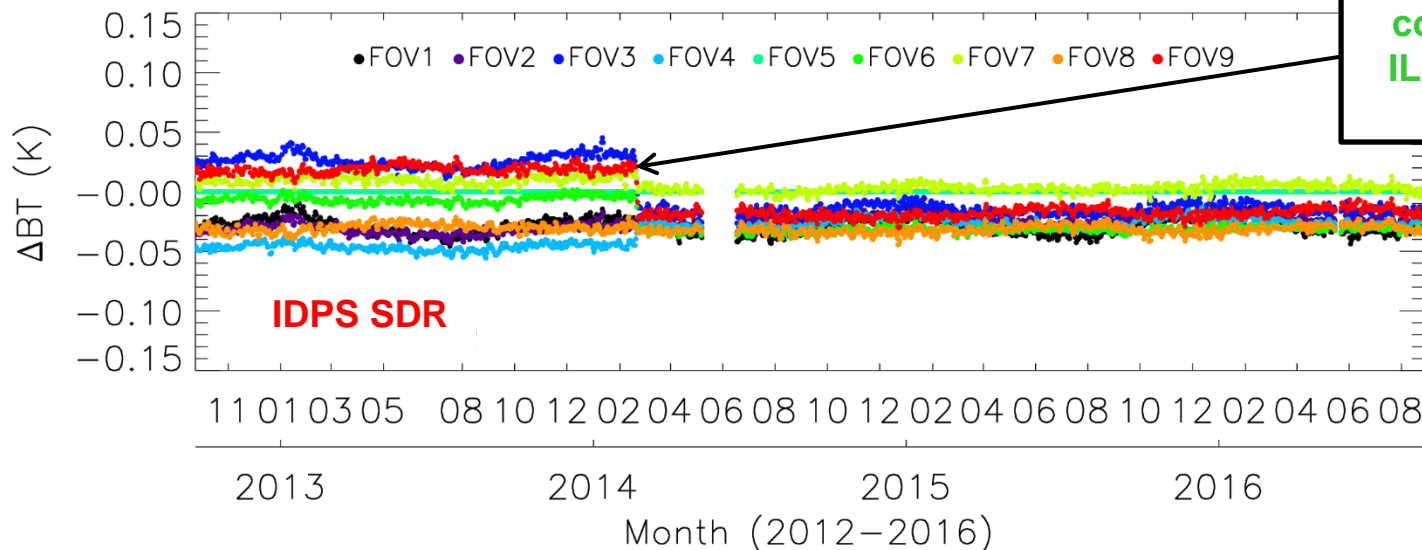
Reprocessed SDR

STAR CrIS Data Reprocessing (2/3)

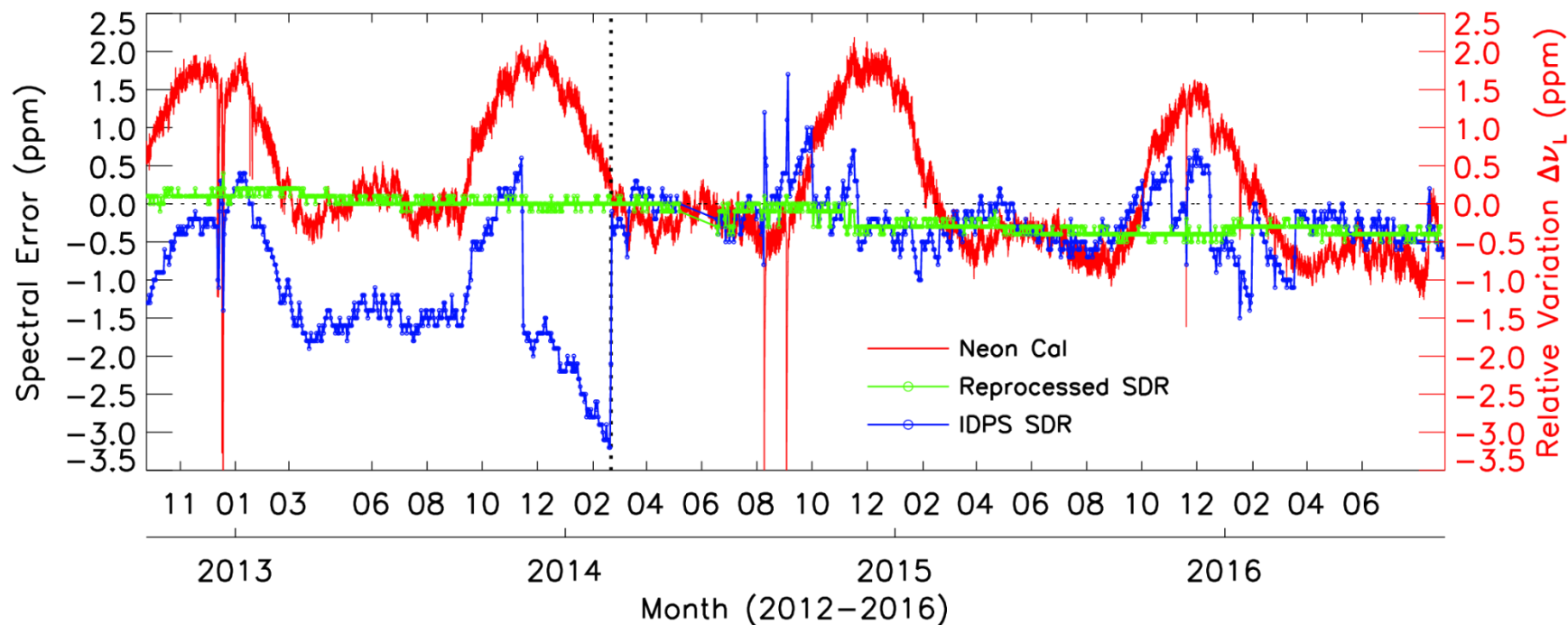
CrIS Radiometric Stability:
Daily Mean FOV-2-FOV Difference wrt FOV5

LW, 672-682 cm^{-1}

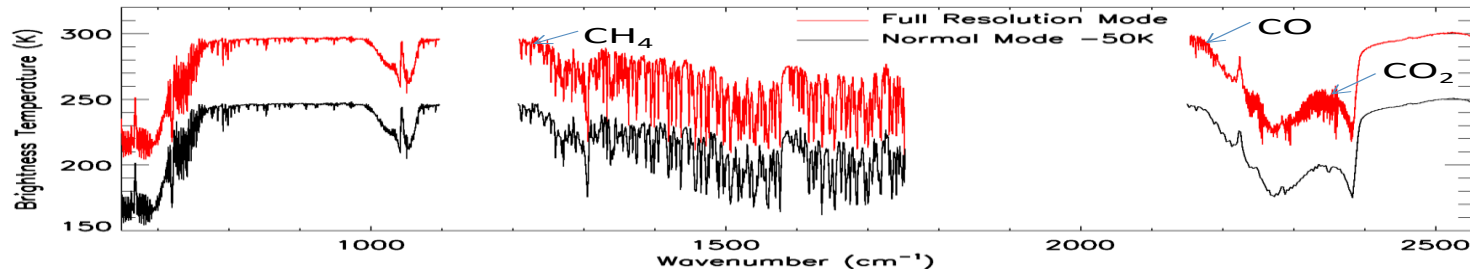
02/20/2014
CrIS non-linearity
coefficient and
ILS parameters
update



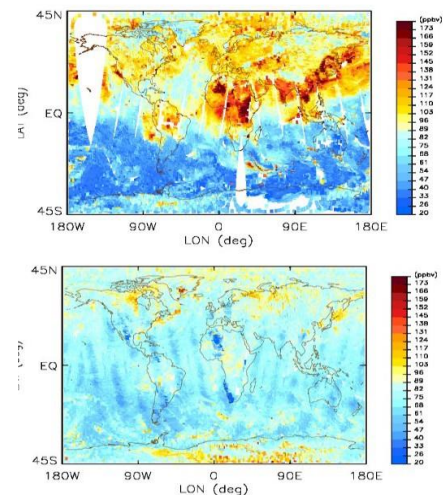
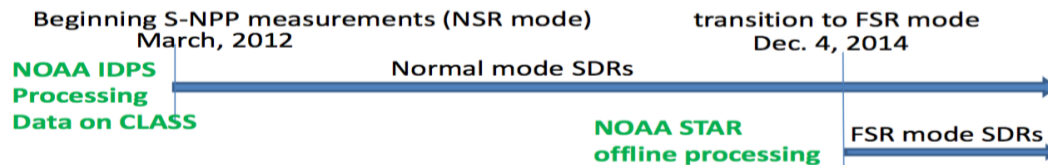
STAR CrIS Data Reprocessing (3/3)



- Comparison of the Neon subsystem spectral calibration versus calibration using the upwelling radiances for IDPS and reprocessed SDRs from September 22, 2012 to August 31, 2016.
- The upwelling calibration has been offset by -0.6 ppm.
- The Neon zero shift time is determined by the Correction Matrix Operator (CMO) update on December 19, 2012. The several sharp spikes in the December 19, 2012, August 9, 2014, and September 2, 2014 are due to NPP spacecraft issues, not CrIS malfunctions.
- The upwelling calibration is for the daily average of FOV5 at nadir (FOR 15 or 16), descending orbit over clear tropical ocean scenes.



Frequency Band	Spectral Range (cm ⁻¹)	Number of Channel	Spectral Resolution (cm ⁻¹)
LWIR	650 to 1095	713 (713)	0.625 (0.625)
MWIR	1210 to 1750	865 (433)	0.625 (1.25)
SWIR	2155 to 2550	633 (159)	0.625 (2.5)



NWP Centers worldwide routinely access CrIS FSR SDRs from STAR FTP servers.

Benefits of full spectral resolution

- Carbon monoxide retrieval becomes viable
 - Useful for air quality application
- Resolve weak water vapor spectral lines to improve upper troposphere water soundings
- Better calibration of 4.3 um band improves lower tropospheric temperature

2/17/2015 NUCAPS CO
FSR (top), NSR (bottom)

- ✓ Meet mission requirements with the state-of-the art retrieval algorithms for consistent mission-long data products
- ✓ SDR/EDR product maturity from beta, provisional, to validated is achieved over the time, and each maturity stage represents an improvement in science quality.
 - Without reprocessing, data products in the archive would have varying accuracy due to periodic updates of algorithms (to fix shortfalls) used for real-time product generation
- ✓ Reprocessing using the most matured (validated) algorithm now part of the cal/val program to validate algorithm corrections/improvements over a large and wide range of representative conditions, with comprehensive documentation of product performance –consistent with the “FULL” (Validated) product performance level.
- Science Benefits, Addressing User Needs
 - ✓ Enable users to utilize high-quality products retroactively to evaluate impacts on user applications.
 - ✓ NWP users requested reprocessed SDRs for their next reanalysis plan

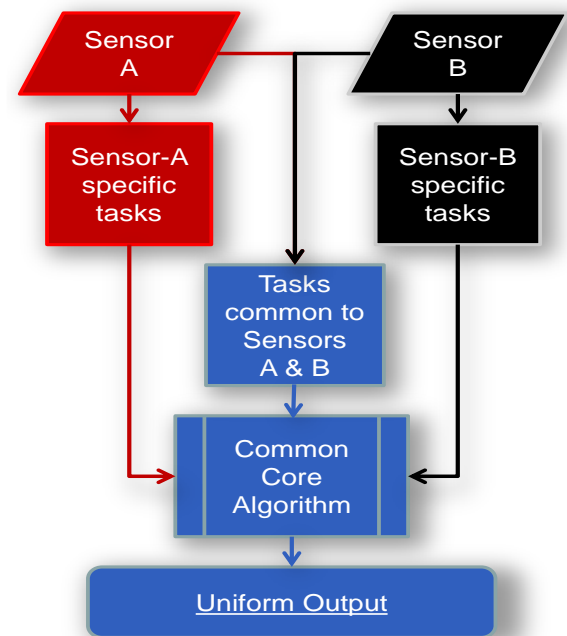
Consistent long-term product quality metrics can only be achieved through reprocessing with algorithms that has reached validated maturity.

Reprocessing workshop: <https://www.star.nesdis.noaa.gov/jpss/meetings2016.php>

- JPSS STAR science teams have implemented many of the S-NPP priority 3 and 4 EDRs using enterprise algorithms.
- Evaluation of JPSS Enterprise algorithms/EDR products show enhanced performance/APUs
 - Same method (physics and assumptions) and its realization (software) are applied to retrieve regardless of source of satellite input
 - Optimizes processes and use of resources
 - Instrument specific tasks are built around a common core

Benefits

- Brings continuity of NOAA products between current and future NOAA operational satellites
- Supports NWS's strategy of multi-sensor algorithms and products
- Cost-effective processing for NOAA products
- Maintenance of fewer algorithms and systems within operations



Examples of Enterprise Algorithms operating in NDE

- ✓ VIIRS Enterprise Cloud Mask (ECM), Aerosol Optical Thickness and Detection products (AOT, ADP)
- ✓ NOAA Unique Combined Atmospheric Processing System (NUCAPS) products using hyper-spectral CrIS and ATMS
- ✓ Microwave Integrated Retrieval System (MIRS) products from ATMS.
- ✓ Ozone EDR product suite (V8TOz and V8Pro)

Completion of S-NPP algorithm transition to **Enterprise Algorithms**: Summer of 2018

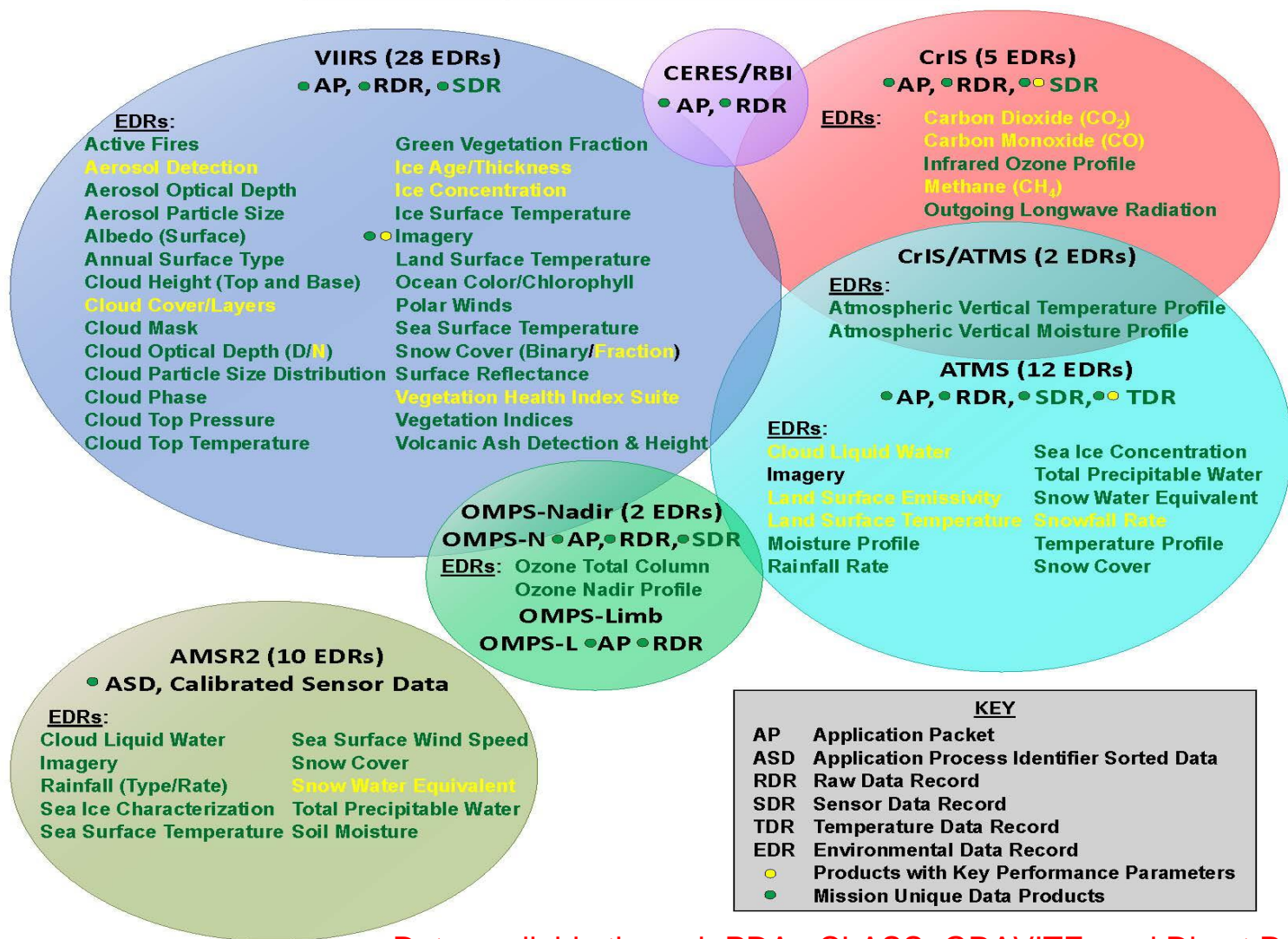
Enterprise Algorithm Status		
Aerosol Detection (VIIRS)	Global Annual Surface Type (VIIRS)*	Rainfall Rate (ATMS)
Active Fires (VIIRS)	Green Vegetation Fraction (VIIRS)	Sea Ice Characterization (AMSR-2)
Aerosol Optical Depth(VIIRS)	Ice Age/Thickness (VIIRS)	Sea Surface Temperature (AMSR-2)
Aerosol Particle Size (VIIRS)	Ice Concentration (VIIRS)	Sea Surface Temperature (VIIRS)
Albedo (Surface) (VIIRS) 2018*	Ice Concentration (ATMS)	Sea Surface Wind Speed (AMSR-2)
AMSR Calibrated Sensor Data (AMSR-2)	Ice Surface Temperature (VIIRS)	Snow Cover/Depth (AMSR-2)
Atmospheric Vertical Moisture Profile (CrIS/ATMS)	Imagery (AMSR-2)	Snow Cover (ATMS)
Atmospheric Vertical Temperature Profile (CrIS/ATMS)	Imagery (ATMS)	Snow Cover (VIIRS)
Carbon Dioxide (CO) (CrIS)	Infrared Ozone Profile (CrIS)	Snow Water Equivalent (ATMS)
Carbon Monoxide (CO2) (CrIS)	Land Surface Emissivity (ATMS)	Snow Water Equivalent (AMSR-2)
Cloud Cover/Layers (VIIRS)	*Land Surface Temperature (VIIRS) 2018*	Soil Moisture (AMSR-2)
Cloud Height (Top and Base) (VIIRS)	Land Surface Temperature (ATMS)	Surface Reflectance (VIIRS)
Cloud Liquid Water (AMSR-2)	Methane (CH4) (CrIS)**	Surface Type (AMSR-2)
Cloud Liquid Water (ATMS)	Moisture Profile (ATMS)	Temperature Profile (ATMS)
Cloud Mask (VIIRS)	Ocean Color/Chlorophyll (VIIRS)	Total Precipitable Water (AMSR-2)
Cloud Optical Depth (VIIRS)	Outgoing Longwave Radiation (CrIS)	Total Precipitable Water (ATMS)
Cloud Particle Size Distribution (VIIRS)	Ozone Nadir Profile (OMPS-N)	Vegetation Indices (VIIRS) 2018
Cloud Phase (VIIRS)	Ozone Total Column (OMPS-N)	Vegetation Health Index Suite (VIIRS)
Cloud Top Pressure (VIIRS)	Polar Winds (VIIRS)	Volcanic Ash Detection And Height (VIIRS)
Cloud Top Temperature (VIIRS)	Precipitation (Type/Rate)(AMSR-2)	

Generated in ESPDS, Products available through PDA, CLASS

DAP delivered, Operational implementation in 2018

*Global (annual) Surface Type is generated by STAR

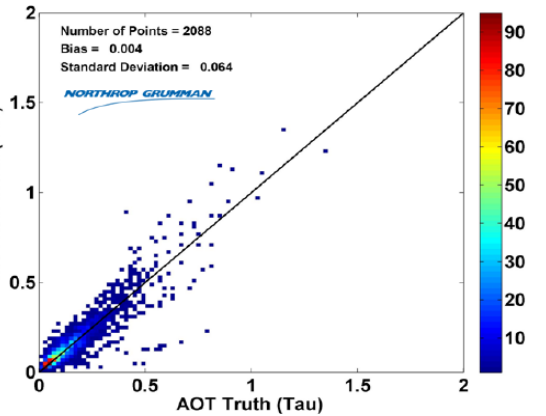
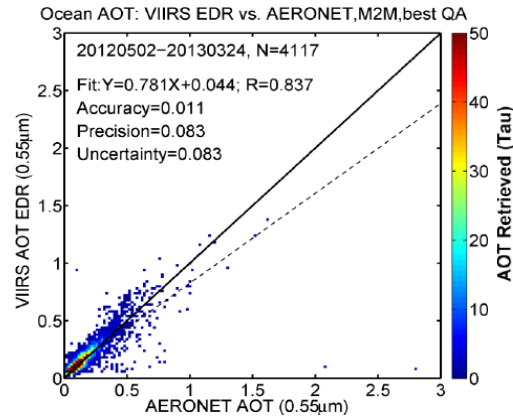
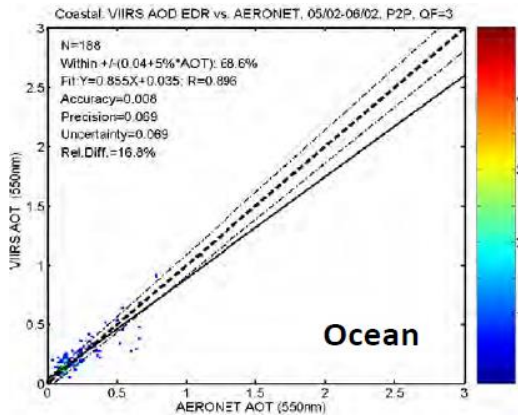
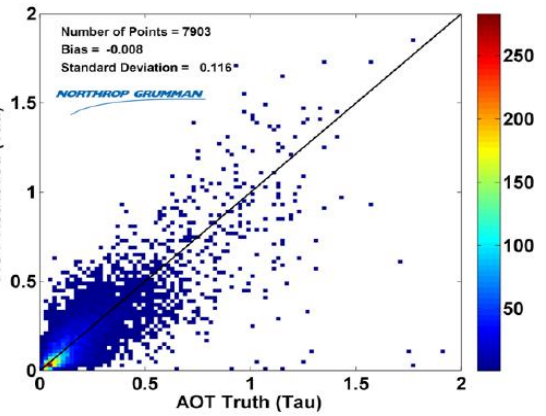
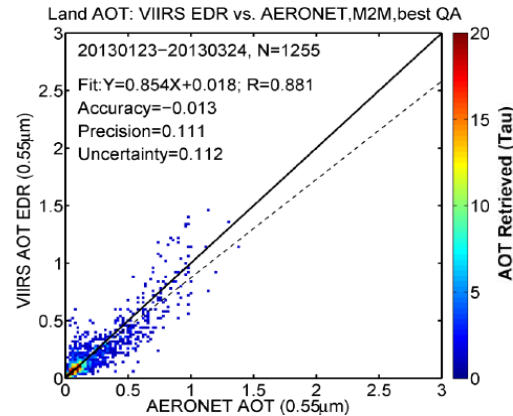
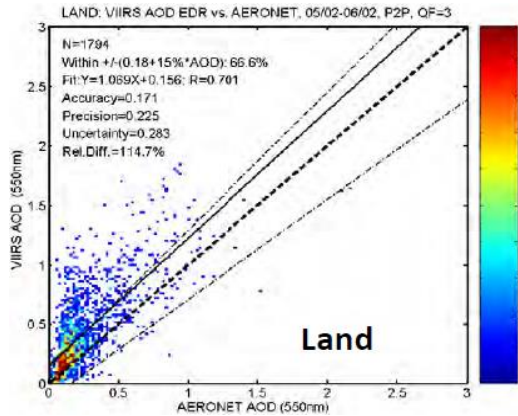
JPSS Program Data Products



Data available through PDA , CLASS, GRAVITE, and Direct Readout

Example: Aerosol: VIIRS AOT EDR vs. AERONET AOT

APU: Beta - -> Provisional - Validated



VIIRS AOT EDR vs. AERONET AOT		Beta (# of samples)	Provisional (# of samples)	Validated (# of samples)
Accuracy	Land	0.171 (1794)	-0.013 (1255)	-0.008 (7903)
	Ocean	0.008 (188)	0.011 (4117)	0.004 (2088)
Precision	Land	0.225 (1794)	0.111 (1255)	0.116 (7903)
	Ocean	0.069 (188)	0.083 (4117)	0.064 (2088)

S-NPP SDR/EDR Product Maturity Status:

S-NPP Products Reached Validated Maturity and are in Long Term Monitoring Phase

Sensor	Algorithm	Beta	Provisional	Validated
ATMS	ATMS SDR	Jan-2012	Oct-2012	Dec-2013
CrIS	CrIS SDR	Apr-2012	Oct-2012	Dec-2013
VIIRS	VIIRS SDR	Apr-2012	Oct-2012	Dec-2013
OMPS	OMPS SDR: NTC & NP	Feb-2012	Oct-2012	Aug-2015
VIIRS	Imagery (Not Near-Constant Contrast)	May-2012	Jan-2013	Jan-2014
VIIRS	NCC Imagery	Oct-2012	Aug-2013	Jan-2014
VIIRS	Cloud Mask	Jun-2012	Jan-2013	Jan-2014
VIIRS	Cloud Property Algorithms	Jun-2013	Jan-2014	Sep-2014*
VIIRS	Aerosol Optical Thickness and Particle Size	Sep-2012	Apr-2013	Aug-2014
VIIRS	Aerosols Detection Product	Jun-2013	Dec-2015	**
VIIRS	Ice Surface Temperature	May-2013	Aug-2013	Jan-2014
VIIRS	Sea Ice Concentration and Ice Thickness	May-2013	Nov-2013	**
VIIRS	Binary Snow Cover	May-2013	Nov-2013	Jan-2014
VIIRS	Fraction Snow Cover	May-2013	Nov-2013	**
VIIRS	Active Fires	Oct-2012	Aug-2013	Sep-2014
VIIRS	Land Surface Temperature	Dec-2012	Apr-2013	Dec-2014
VIIRS	Land Surface Albedo	Jun-2013	Apr-2014	Dec-2014
VIIRS	Surface Type	Feb-2013	Jan-2014	Dec-2014
VIIRS	Land Surface Reflectance	Feb-2013	Aug-2013	Sep-2014
VIIRS	Vegetation Index	Feb-2013	Aug-2013	Sep-2014
VIIRS	Ocean Color	Jan-2013	Jan-2014	Mar-2015
VIIRS	Sea Surface Temperature	Feb-2013	Jan-2014	Sep-2014
CrIS	Soundings	Aug-2012	Jan-2013	Sep-2014
OMPS	Total Column Ozone EDR	Jul-2012	Jan-2013	Aug-2015
OMPS	Nadir Profiler Ozone EDR	Aug-2012	Jan-2013	Aug-2015

More Details: <https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php>

**** Use Enterprise Products for Product Maturity**

Each maturity stage represents an improvement in science quality

- S-NPP EDRs Reprocessing
 - Enterprise algorithms/products implemented for Suomi-NPP are either operational or close to operations with algorithm maturity acceptable for reprocessing.
 - EDR Reprocessing efforts are on the way to create consistent record of S-NPP data products by removing the artifacts, biases, error processing; to maximize impacts on NWP forecasting and climate applications
 - VIIRS SST, Ocean Color, OMPS: Ozone, CrIS: Soundings and other product science teams have reprocessed data products.
 - Evaluation of the enterprise algorithms implemented in various systems, e.g. GOES-R and JPSS, to optimize the enterprise algorithm.
 - Working to identify computational resources, product dependencies to setup reprocessing chains for implementation either as individual systems or through framework integration.
- Working with the users in identifying the user needs for reprocessed products
 - How do we reprocess systems that have had channels go bad or have lost instruments entirely in case if the EDR product uses multi-instrument SDRs?

- Consistent Mission Long S-NPP/NOAA-20 SDR/EDR Products
 - ✓ Meet mission requirements with the state-of-the art retrieval algorithms for consistent mission-long data products
 - ✓ EDR products get impacted both by upstream SDR product changes (due to uncovered deficiencies and improved sensor characterizations in SDR algorithms) as well as EDR algorithm changes
 - Without reprocessing, data products in the archive would have varying accuracy due to periodic updates of algorithms (to fix shortfalls) used for real-time product generation
- Science Benefits, Addressing User Needs
 - ✓ Enable users to utilize high-quality products retroactively to evaluate impacts on user applications.
 - ✓ NWP users requested reprocessed SDRs for their next reanalysis plan

JPSS Instruments/Data

• Raw Data Records

Raw data generated by sensors on the satellites.



• Sensor Data Records (SDRs)

Science algorithms that perform calibration and geo-location are applied on the RDRs to produce SDRs and Temperature Data Records (TDRs, for MW instruments).



• Environmental Data Records (EDRs)

Geophysical parameters that are derived by applying retrieval algorithms on the SDRs.

- VIIRS Imagery Products
- Atmospheric Products
- Land Products
- Ocean Products
- Cryosphere Products



• Blended Products

Fusion of baseline products derived from a multitude of satellite sensors such as ATMS, AMSR-2, etc.

Reprocessing workshop: <https://www.star.nesdis.noaa.gov/jpss/meetings2016.php>

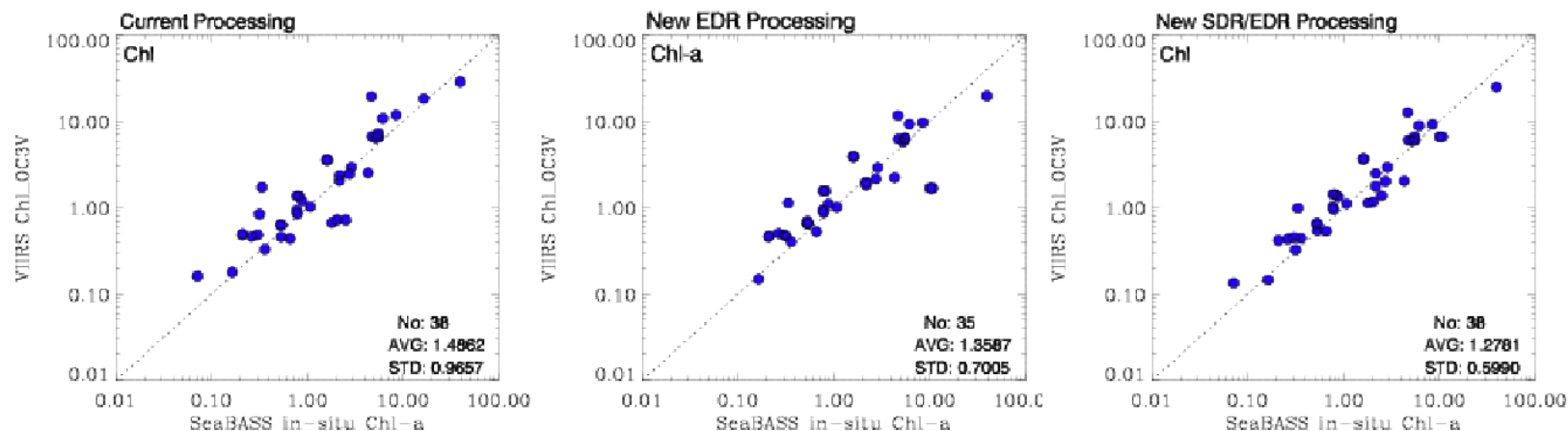
Reprocessing for Consistent Mission Long S-NPP EDR Products



- EDR products get impacted both by upstream SDR product changes (due to uncovered deficiencies and improved sensor characterizations in SDR algorithms) as well as EDR algorithm changes through beta, provisional, and validated maturity stages, and upstream EDR algorithm changes.
- Without reprocessing, data products in the archive would have varying accuracy due to periodic updates of algorithms (to fix shortfalls) used for real-time product generation.
- Enable users to utilize high-quality products retroactively to evaluate impacts on user applications.
 - Setup a baseline for further advancement of observational data records

Consistent long-term product quality metrics can only be achieved through reprocessing with algorithms that has reached validated maturity.

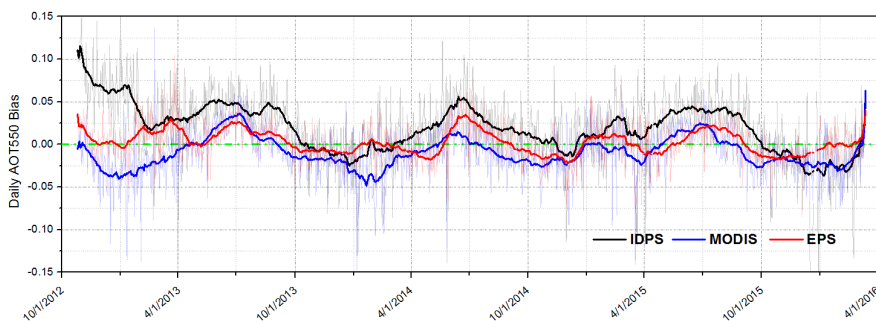
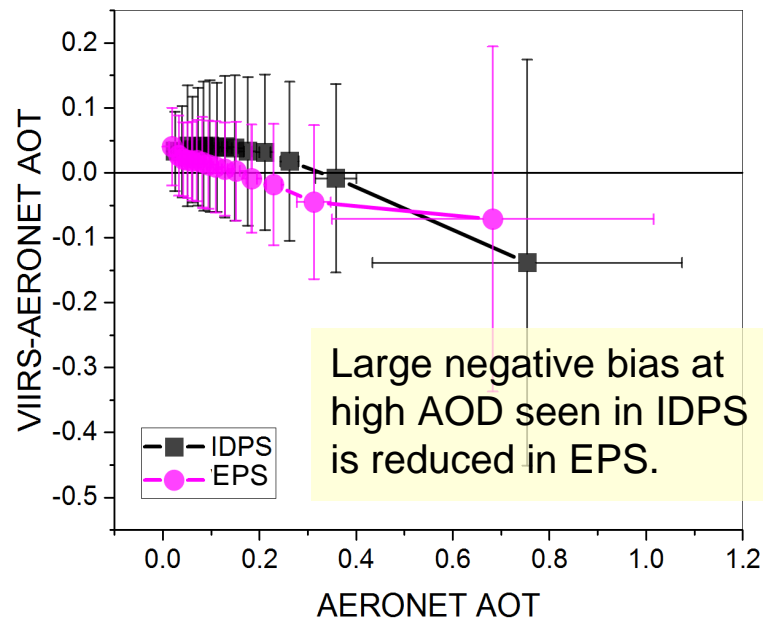
Reprocessing workshop: <https://www.star.nesdis.noaa.gov/jpss/meetings2016.php>



	Ratio of OC3V/Chl			OC3V vs Chl			log(OC3V) vs log(Chl)			No
	AVG	MED	STD	Slope	Intcpt	R ²	Slope	Intcpt	R ²	
Current Data Processing	1.4862	1.2273	0.966	0.812	1.225	0.78	0.866	0.112	0.81	38
New EDR Processing (2015-03-19)	1.3587	1.2210	0.701	0.487	1.391	0.66	0.743	0.102	0.77	35
New SDR/EDR Processing (2015-02-26)	1.2781	1.1933	0.599	0.652	1.099	0.83	0.857	0.085	0.89	38

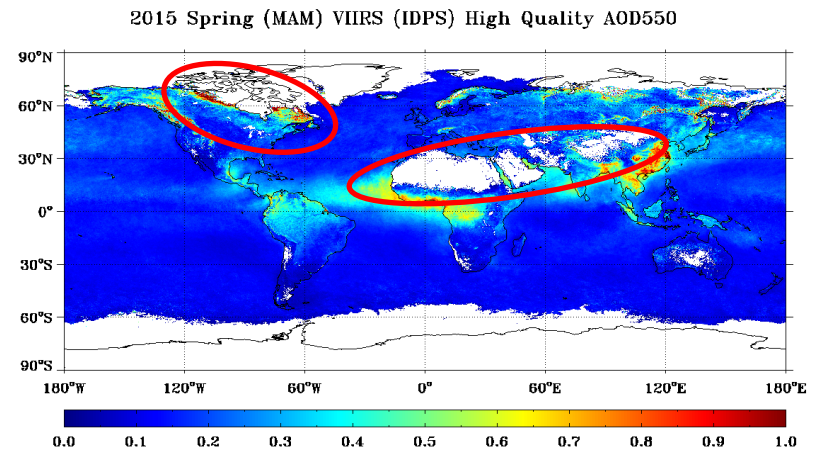
The MSL12 Ocean Color Processing system produces NRT products (meeting latency requirements) for many real-time applications. Science quality OC products are produced at the expense of latency for applications requiring better accuracy and for incorporation into longer time series needs, such as the integrated ecosystem approach for fisheries management applications (**Ocean Color Lead: Menghua Wang**)

Ocean Color Data Sets: <https://www.star.nesdis.noaa.gov/socd/mechb/color/>

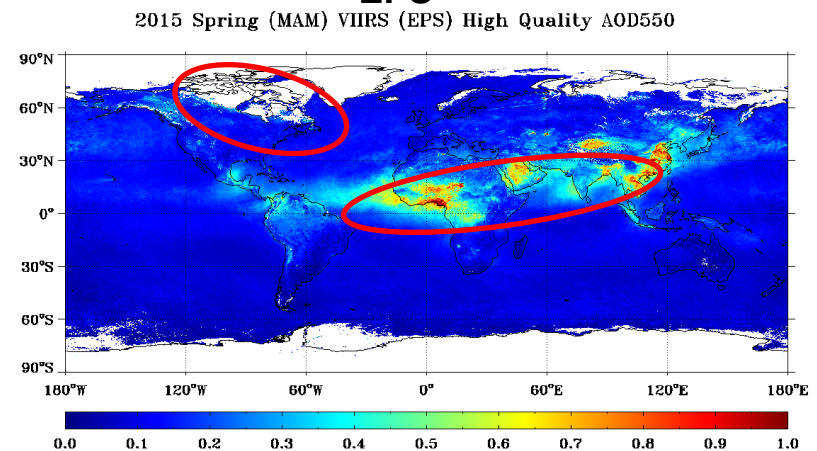


IDPS: Interface Data Processing Segment (current operational system)
EPS: Enterprise Processing System for NOAA Data Exploitation (NDE) operational system

IDPS

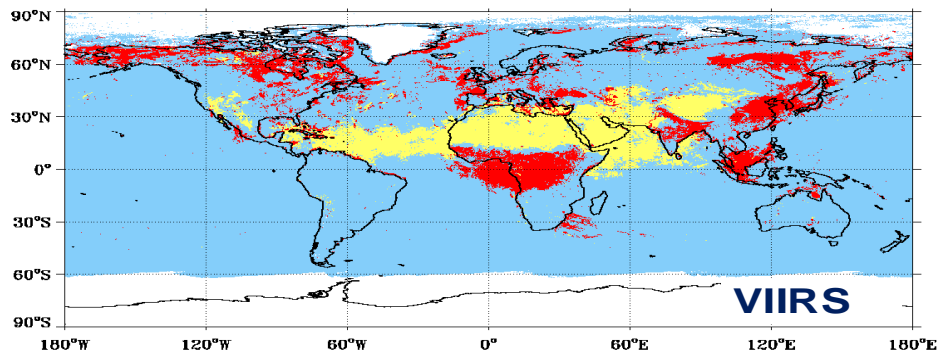


EPS

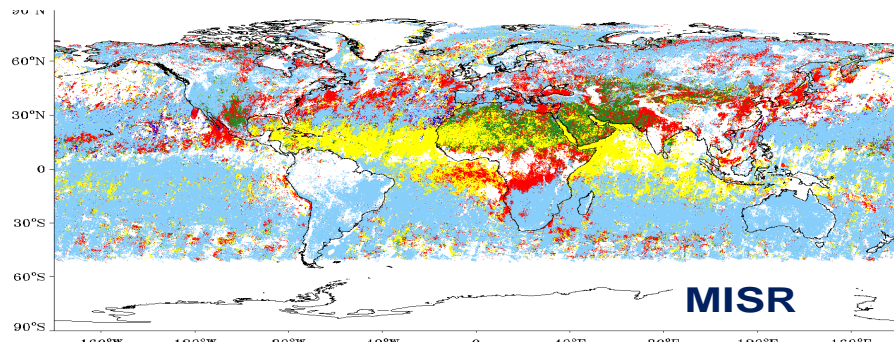


Aerosol Leads: **Istvan Laszlo/Shobha Kondragunta**

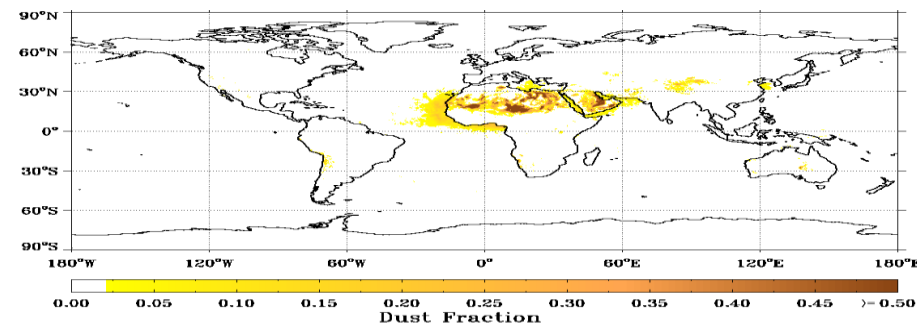
Aerosol EDRs: Aerosol Detection



- VIIRS Aerosol Detection Product is in good agreement with MISR with respect to location of dust and smoke.
- Both dust and smoke products meet requirements



- **Enterprise ADP Algorithm Status:**
 - Algorithm is ready
 - Operational since July 5, 2017
- **Reprocessing:**
 - with EPS algorithm
 - 2015 completed; other years ongoing

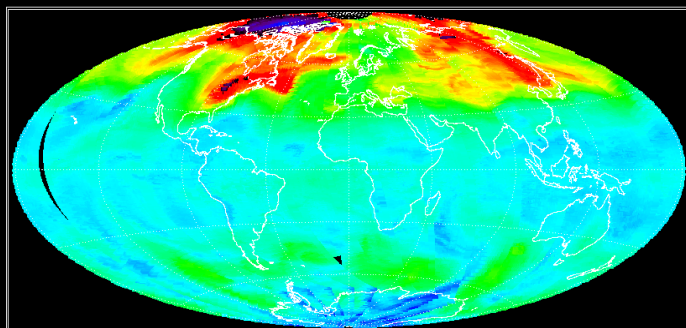


NOAA-eidea website

<https://www.star.nesdis.noaa.gov/smcd/spb/qa/eidea/>

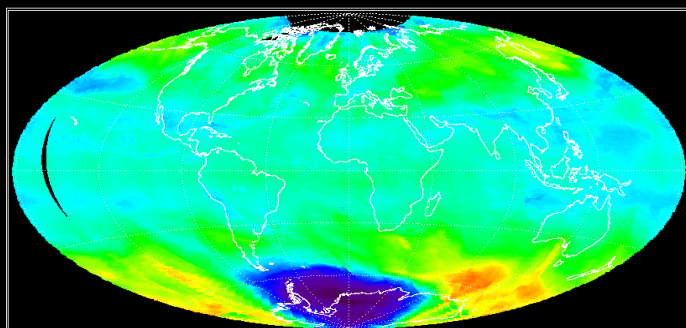
Aerosol Leads:
Shobha Kondragunta/Istvan Laszlo

V8TOz Daily Total Ozone Products



100 200 300 400 500

March 14, 2017 NH, Maxima

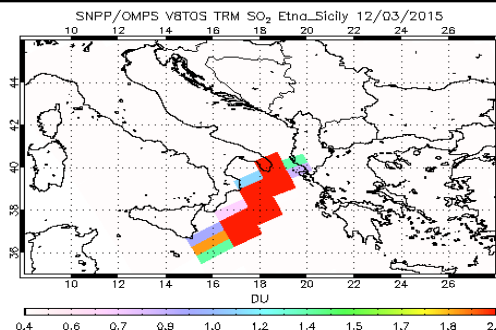


100 200 300 400 500

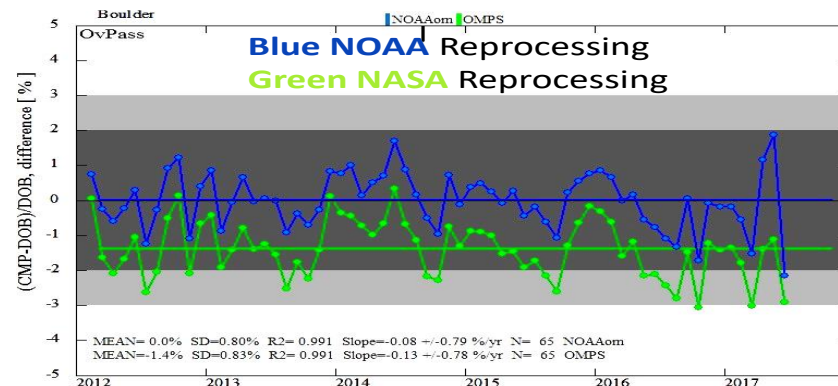
2016 SH Ozone Hole

OMPS EDR Products

- Total Ozone, using the version 8 algorithm
- Ozone profile, using version 8 algorithm
- SO₂, Linear Fit SO₂ method (LFSO₂)



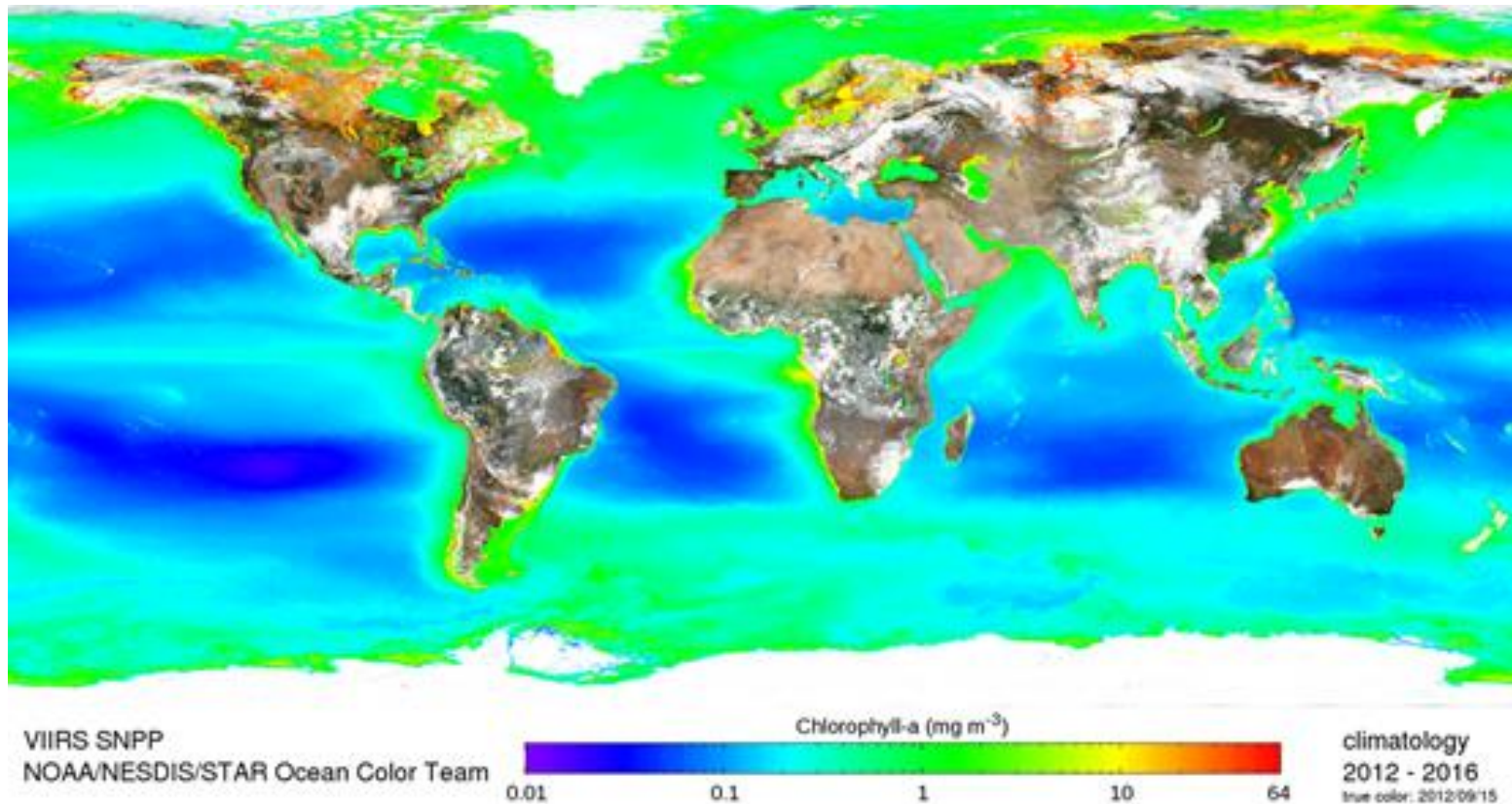
Estimated SO₂
over active
volcanos



Monthly average percent differences for OMPS total ozone estimates for overpass data compared to NOAA Dobson Station in Boulder CO

OMPS Lead(s): Larry Flynn (EDRs), Trevor Beck (SDRs)

S-NPP VIIRS Ocean Products

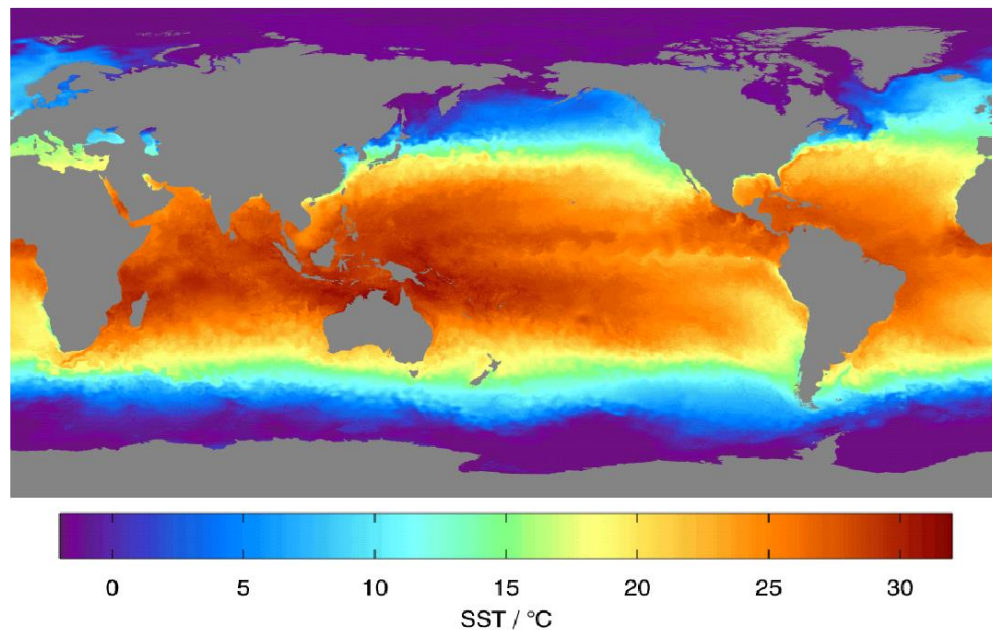


S-NPP Ocean Color Product Climatology generated through VIIRS mission-long reprocessed data Ocean Color Lead: Menghua Wang.

<https://www.star.nesdis.noaa.gov/socd/mecb/color/>

These 5-km blended SST analyses are produced daily from 24 hours of polar and geostationary sea surface temperature satellite retrievals:

- S-NPP/NOAA-20
- Metop-B,
- GOES-E/W
- Meteosat-10
- MTSAT-2 (will be replaced by Himawari-8 in late 2015.)
- **SST Lead: Sasha Ignatov**

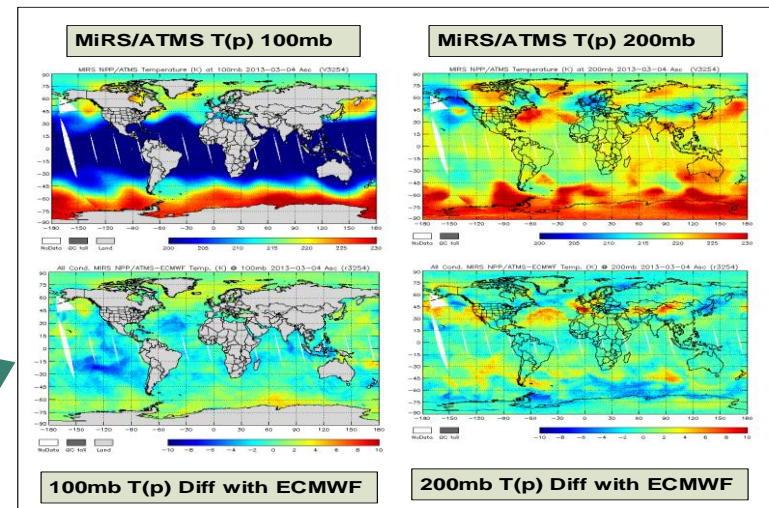
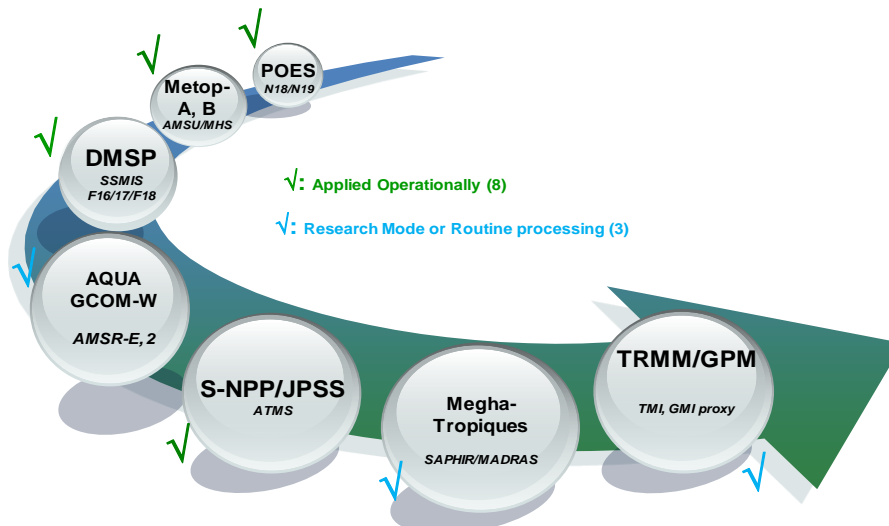
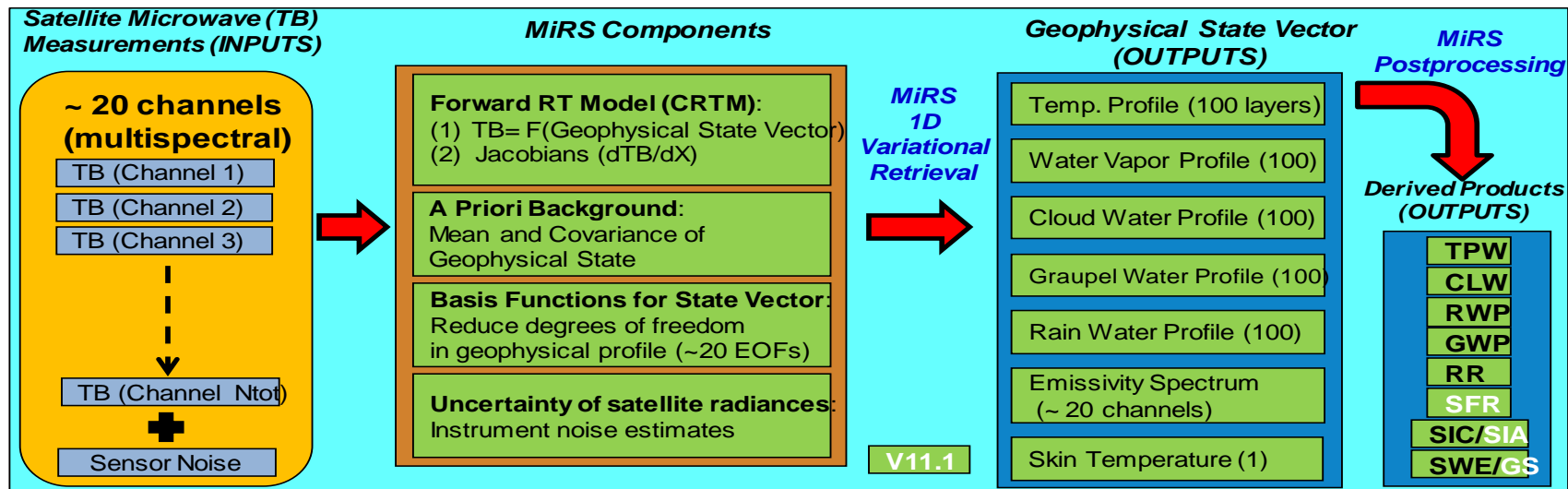


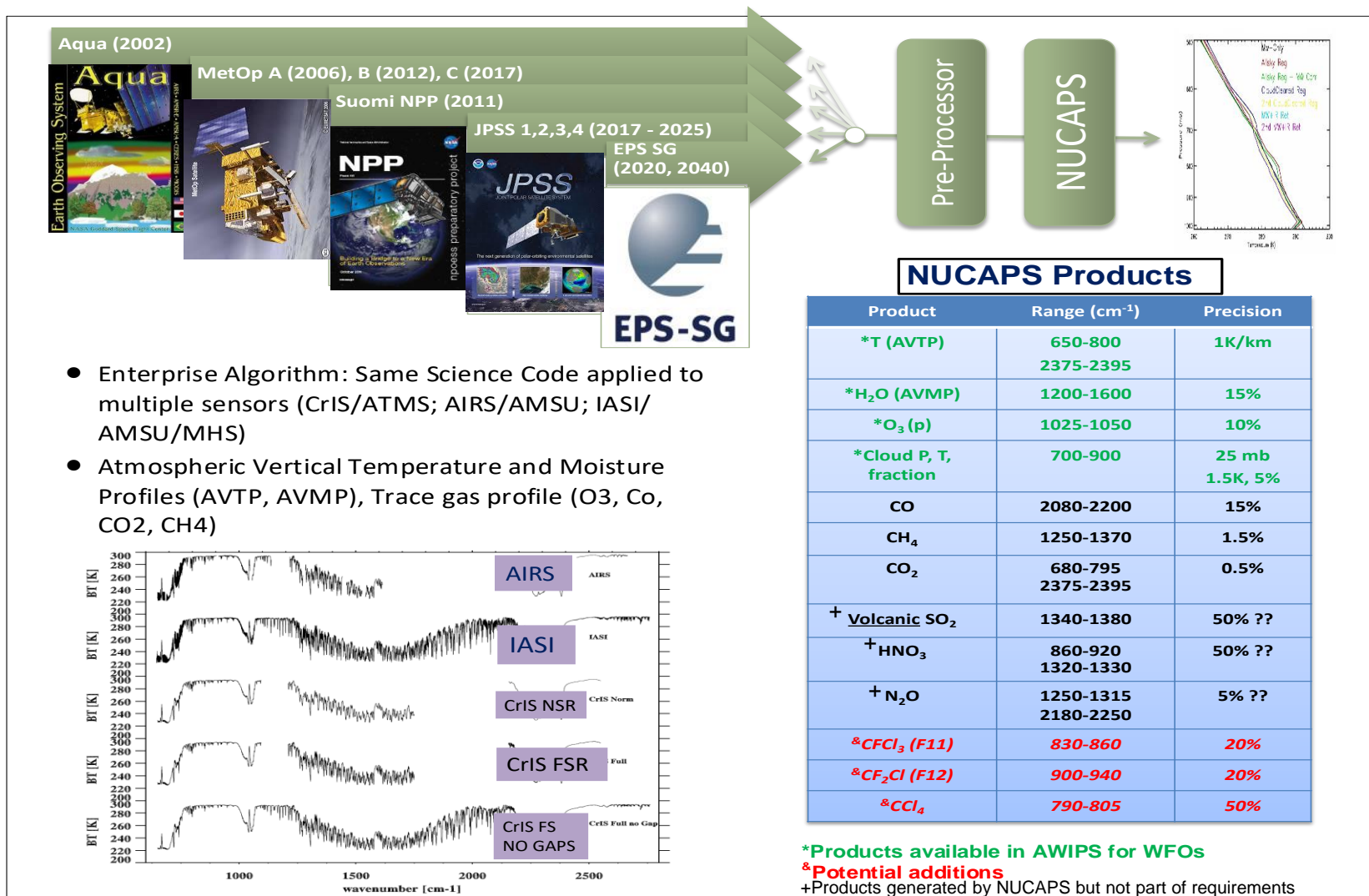
PHASE I 2004 to present
September 2015

PHASE II 1994 to 2004
September 2016

Coral Reef Watch will use the latest 5 km global blended SST to generate a new climatology for their bleaching alert and monitoring products for the coral reefs around the globe.

SST website: <https://www.star.nesdis.noaa.gov/jpss/SST.php>
<https://www.star.nesdis.noaa.gov/sod/sst/arms/>





NUCAPS EDR Leads: Lihang Zhou, Antonia Gambacorta

Applications of Suomi NPP Reprocessed Data in Climate Research

- NWP reanalysis using Suomi NPP reprocessed data (e.g. NASA GMAO)
- Climate data record (40 years) of microwave sounder radiances and products from MSU/AMSU/ATMS, temperature, moisture, precip., etc
- Climate data record (40 years) of infrared sounder radiances and products from SSU/HIRS/CrIS; and hyperspectral sounders (AIRS, IASI, CrIS), atmospheric temperature, moisture, trace gases. etc
- Climate data record (40 years) of global data products from polar satellite imagers (AVHRR, MODIS, VIIRS), such as Clouds, Aerosols, Ice and Snow, SST, LST, Albedo, Surface Type, Vegetation, Ocean Color, etc
- Climate data records of global trace gases (Ozone, CO, CO₂, CH₄, etc)